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A tool for enhancing interactions during crises and aiding collective decision-making

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ABSTRACT

This work focuses on how individuals interact and make collective decisions during crisis situations. We developed a prototype to aid the decision-making process by focusing on how to facilitate the “correct information to the correct agent” problem as well as encouraging new and agile behaviour. Our software is based on real life case studies documented during Hurricane Katrina and the Fukushima Nuclear disaster and an analysis of social media communications during Hurricane Sandy. Communication is broken down into three categories (command, report and personal) and we developed a formal grammar for these. IntCris is then the implementation of this formal grammar (all communications requirements) as well as additional features essential for interaction during such circumstances.

Keywords

Collaborative technology, emergency response, decision-making software.

RELEVANT WORK

The software was developed on Ipad, seeing as the ability to take the devices on the field is particularly important. Similar work has been carried out in [1]. Here software is developed to aid collaborative learning in an “Out There and In Here” system. The idea is that there are two groups of students, one learning “on the field” and another “in here” able to take advantage of technology and resources at their disposal to aid in sensemaking and in divulging relevant information. We are unaware of what the “in here” portion of this system would mean for our software, but can hypothesise the possibility of synchronizing IntCris to something akin to the social media command centers we have witnessed so many agencies develop. A pioneering example is given by Red Cross’ social media command center [5], which was followed by several agencies involved in disaster management. The social media usage is no different to what we can witness in most post-disaster management companies and includes responding to requests in real time as well as using social media to understand patterns in what affected communities need (so active help and information gathering). In addition, like many organizations it posts useful information to the public, whether during a crisis or not. Social media considerations are encompassed in our studies by analyzing

the sort of communications that happen through social media during a crisis, specifically Hurricane Sandy. This analysis was then carefully implemented.

Several emergency response organizations have created apps from their point of view, a comprehensive and up-to-date list can be found in [10]. However, these apps typically focus on a single point of view, they focus on one thing such as reporting, crowd sourcing or providing information only relevant to the particular organization. Ours is different since it incorporates several different aspects with a focus on collective decision-making and in communication and interaction between several individuals, agencies and coalitions.

Work that attempts to harness collective intelligence can also be compared to ours, since this is in part what we are attempting to do. We wish to enhance interactions between people during crisis, through technology and also to gather information in a way that filters out irrelevant data, by attempting, in a way, to “harness” the collective intelligence of users, allowing them to make better individual and group decisions. Several examples of collective intelligence applications can be found in [2]. Famous examples include Wikipedia and Gooogle (harnesses information from several websites).

Lastly, technologies that facilitate group decision-making are also relevant, a starting point to understanding literature on those can be found in [3]. An example is given by MIT’s Collaboratorium [6], developed to facilitate discussion, based on argumentation theory and tested on a community of 220 graduate students, on the topic “the future of biofuels in Italy”.

DESCRIPTION OF PROTOTYPE

Case studies from Hurricane Katrina and the Fukushima Nuclear Disaster, together with an analysis of social media during Hurricane Sandy, provide the foundation to understanding what sort of interactions occur during crises and how technology might facilitate positive behaviour. These studies lead to the creation of a list of features and a formal grammar for communications during crisis (we broke the communication down to personal, command and report). By personal we mean notes individuals take to themselves with the option to share it via social media or

reporting (Figure 1). Command can be official and unofficial, as can be reporting. Different segments of the grammar are implemented as different elements of the prototype; we will now go into further detail of this and exemplify the complete grammar with two segments, the case studies for those segments have been published in [8][9]. For anonymity purposes, most information on screenshots is demonstrative only, when it is based on real-life events we will make this clear.

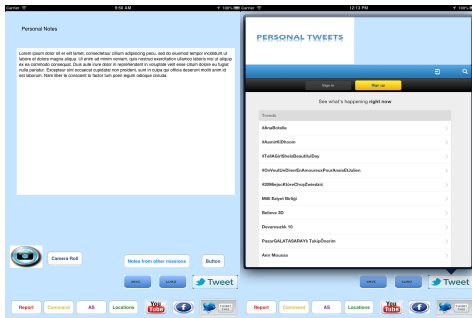


Figure 1. Personal Notes.

Implementing aspects of the case studies

Social Media

We have analysed social media (Twitter, Reddit and Facebook) interactions during Hurricane Sandy (for example [4]) and noted that individuals and organizations mainly use this medium to seek and divulge information that seems relevant to them but typically without narrowing a target audience. Our application adds to this by attempting to narrow an audience by categorizing part of incoming data, mainly done at the level of the user input. Users can post on social media on any of the three communication categories and social media feeds also happen at these distinct categories. In addition we have feeds from specified organizations and named individuals. Figure 6 shows an example of a user turning a command into a Twitter feed (pop up on sending a command page) and Figure 1 has an example of incoming tweets from a user (pop up on personal notes page); both examples are left blank for anonymity purposes.

Coordination

During Hurricane Katrina we observed a failure to coordinate different missions within the same and across different organizations and hence we added single mission and multi-mission views, so the user can see details of a single mission as well as how it coordinates with other missions (official and unofficial). In an attempt to help users get a clear view of how everything is linked we have implemented the following:

- From a “single” command (or report) view, it is possible to view how that particular command (or report) links to other commands and reports within the same mission and across different missions.
- From the tree of commands (reports) within the same mission and across different missions, it is possible to select a single command tree and view that. (Figure 2)

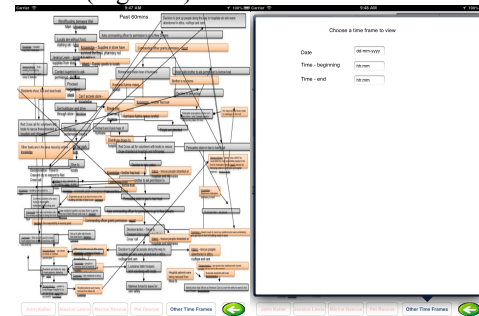


Figure 2. Example of a multimission tree view. Clicking on a subtree directs users to a particular mission. On the right you can see the user searching for alternative time frames. The particular view shown (left) is taken from events observed during Hurricane Katrina.

Learning

The chosen approach to dealing with unexpected situations means that the “system” (collection of rules and known ways to achieve goals) has to learn new behaviour, as specified in the command grammar. In IntCris, it is possible to view which commands were successfully completed “as expected” and which ones generated new behaviour. This can be found in the grammar segments and implementation (figures 4-7). This is based on many examples of agile behaviour observed during Hurricane Katrina, as well as a ripple effect of some new behaviour being transferred across different situations.

New behaviour is also learnt from information sharing, through the reporting mechanism. Another way to share information is through social media and also Personal notes can be transformed into reports and shared with other users via that.

Information Gathering

To gather information, other than the incoming reports and social media feeds, it is also possible to search for locations of shelters and other necessities if/when shared by the organizations involved.

Coalitions

We have observed cases of both formal and informal coalitions, established prior to and ad-hoc during disasters, for example during Katrina a group of friends formed informal understandings with the police and the National Guard who passed them ready meals to distribute as well as information of survivors wishing to evacuate [7]. Figure 3 (left) shows a user being notified that a coalition has been found and Figure 3 (right) shows the coalition; in this case the user clicked on one of the organizations of the coalition and so the pop up page shows the current operations of the chosen organization. All the organizations are not real, this coalition was created for demonstrative purposes.

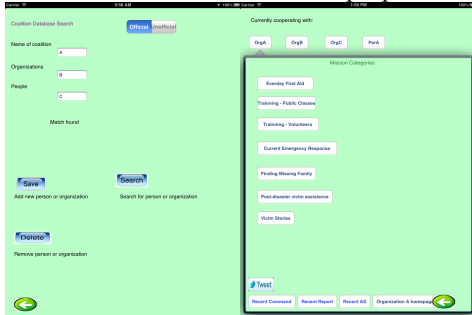


Figure 3. Coalition database - searching and adding.

Formal Description

We will now give samples of the formal language at the foundation of our IntCris.

Reporting grammar (Figures 4 and 5):

Report -> To (From) (ReplyRequired) (VisibleBy) (CommandResponseHouseRule)* (CommandResponseUnexpected)* TimeStamp ReportsSameMission* ReportOtherMissions*

Where () indicates optional and * indicates potential several statements.

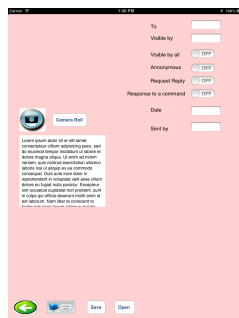


Figure 4. Report grammar used in the implementation to send a report.

Additional reporting implementations not covered by grammar:

- Whether the report a response to a command
- Relation to other reports both from the same and from

different mission

- Time stamp

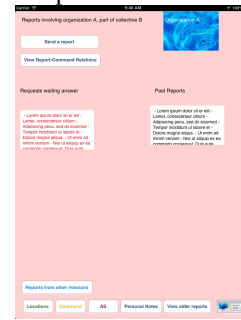


Figure 5. Reports page.

Command Grammar (Figures 6 and 7)

Command -> To From StartState EndState Intent (Method) TimeFrame OtherCommandsMission* OtherCommandsOtherMissions* (Reports)* (ExpectedHouseRules)*

ExpectedHouseRule -> StandardWayCompletion | NewWayNonFailure



Figure 6. Commands page

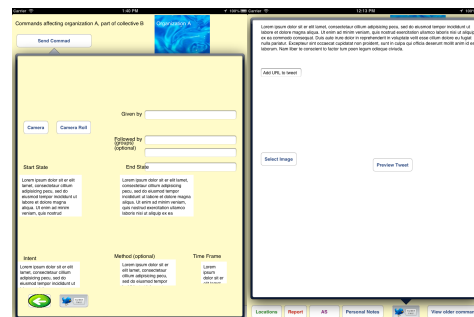


Figure 7. Command grammar used in the implementation to send a command.

CONCLUSION AND FUTURE WORK

We have completed the first step in our research to understand how to create new technology that aids agile behaviour during crisis. We studied real life interaction and communications as well as analysed social media communications in order to create a prototype. The next step will be to observe IntCris being used in simulations

and “in the field” to understand what additional features must be implemented. Even before conducting such studies, we can make some additional hypotheses. For example, the IntCris will be able to harvest information from participating agencies (once they add themselves and allow for information to be harvested via their Twitter or other social media account); information such as ready meals and shelters is crucial for those affected (Figure 7 provides a proof of concept – the application detects user Location and mimics adding information of nearby shelters)

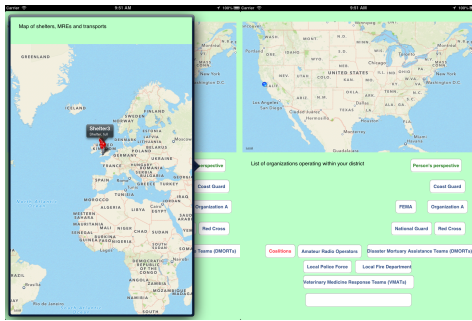


Figure 8. Immediate Information to Victims(left), pop up from initial page(right) – proof of concept. The organizations listed are some of those involved in Hurricane Katrina and are for demonstrative purposes only.

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